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fork and Shields's river. This trip took them up the valley of the East fork to its source, and occupied some three or four days.

During their absence, the remainder of the party were employed in exploring the vicinity of our camp. In company with Dr. Platt, of Waterbury, Conn., I went up the East fork some six or eight miles, and, as was our usual custom, climbed a rather high mountain, south of the river a couple of miles, perhaps. Here we found the summit covered with petrified trees, many of which were lying prostrate — some thirty or forty feet long — upon the surface of the ground. Upon another portion of the summit were many other petrified trees still standing upright where they grew; some were of large size, and afterwards were found by actual measurement to be ten feet in diameter. Many of these fossil trees had been covered with volcanic material, and were seen standing out from perpendicular cliffs, where the volcanic material was weathering away. We hitched our saddle horses to upright stumps of these trees and ate our dinner, and returned to camp laden with the product of this weird mountain-top.

The next day, August 1st, in company with Prof. Wakefield, of Hiram College, I returned to this same peak, and continued my explorations. It was during this day's search that I turned over a large section of a petrified tree which had been hollow, but was now filled with beautiful crystals of amethyst. It was a beautiful sight, and one long to be remembered! We filled our saddlebags and pouches with these crystals, and started off for camp. It was a Mr. Sloane — a graduate of Columbia College — who first met us, and seizing a good-sized specimen, went shouting through camp, "Amethyst! Amethyst!" The entire camp gathered around us in admiration of the crystals, and each one secured a goodly number of crystals for himself.

The next day, Dr. A. C. Peale, our mineralogist, and several others of the party, returned with us to the peak, and found other parts of the same tree, and still other specimens of amethyst from other trees; and from this time forth, *Amethyst* Mountain occupies its place upon all our late maps. It may be interesting to add, that the crystals which were exposed above the ground to the sunlight had entirely lost their violet color, and were simply quartz crystals, while those below the surface, upon the same slab, had retained their color perfectly.

THE LAST SUBMERSION AND EMERGENCE OF SOUTHEASTERN KANSAS FROM THE CARBONIFEROUS SEAS, OR THOSE AFFECTING THE CARBONIFEROUS FORMATION IN KANSAS.

BY E. P. WEST.

The country along the line of the Southern Kansas Railway all through southeastern Kansas and extending westward to Harper, the present terminus of the road, is unsurpassed in beauty and the fertility of its broad fields and valleys. It is said, and truthfully, to be the paradise of the husbandman and the pasturist; and it is no less so of the geologist, the poet, and the artist. Whoever has traveled over the line of this road could not have failed to observe the picturesque and poetic beauty everywhere meeting the eye. Symmetrical mounds rise from the broad plains and valleys, as if by the work of magic, and terraced cliffs, terrace rising above terrace in solemn grandeur, environ the road. Sometimes the cliffs are circular, forming vast amphitheaters, extending back for miles. Those mark the last emergence of southeastern Kansas from the carboniferous seas, and bear unmistakable evidence of powerful and persistent forces which, though perhaps comparatively brief, have left their impress boldly written on every feature of the country. Water-worn pebbles, commonly known as gravel beds, are found in the channels of streams, in the valleys, under the soil, and over the highest mounds and ridges all over the country. They are encountered north of Ottawa, and extend southward into the Indian Territory, westward to beyond Burlington, and eastward into the State of Missouri. How much beyond the limit indicated they extend I am unable to say, but it is probable that their range is much wider. This, however, can only be determined by an exploration of the adjacent country. Independent of their scientific significance, these beds are important in an economic point of view, affording free underdrainage, and supply good and convenient material for road-making. Along the brink of mounds and cliffs, and often for a considerable distance removed from them, as well as on top of the highest ridges and mounds, at and near the surface, the rocks often stand vertically to the plane of stratification, or incline at various degrees from this line. This is notably conspicuous in many places.

Not unfrequently old landslides are to be seen projecting from the mounds, or the brinks of cliffs, and extending out for hundreds of feet. Indeed the whole country wears the appearance of having once formed the bed of shallow seas, divided into numerous channels of various widths. Some of the cliffs, during the recession of the water, perhaps, formed coast lines, while the higher lands may have been low islands. Such is the condition of things conspicuously marked over the entire area named. To what cause is this great work to be attributed? It could not have been done by rivers, for the pebbles, though water-worn, are too widely distributed for the work of the broadest of such streams. It was not effected by glaciers, for the vast landslides, the conformation of the mounds and cliffs, the vertical position of the rocks where the stratification has been disturbed, the absence of erratic rocks, and the want of the commingling of the local rocks, all preclude this idea. If it had been caused by glacial action, there would have been an intermingling of all the rocks torn down, indifferently. This, however, is not the case anywhere in the district observed. Neither are the beds composed of altered drift, for if they were so they would be homogeneous in their general distribution; but this is not found to be the case, for in some localities they are composed of chert alone, while in others they contain small broken fragments of sand-rock alone: in each instance identical with the adjacent local rocks. No erratic, trap or igneous rocks, or limestone, is anywhere to be found intermingled in the beds. The absence of trap and igneous rocks is to be accounted for from the fact that the glaciers did not extend so far south. The absence of limestone, though the prevailing local rock of the country, will be explained farther on. It was not caused by volcanic action, upheaval, or folding of strata, for the under strata rest undisturbed. Though evidently not caused by any of these agencies, the mounds, the terraces, the cliffs, the water-worn pebbles, and broad plains and valleys are conspicuous, grand and picturesque facts which stand out in bold relief in the entire district, and prove a widespread destruction of its former surface. The whole country, indeed, has been denuded for from at least fifty to two hundred feet in vertical thickness, leaving the more impregnable mounds and cliffs, the pebble-beds, and broad plains and valleys, standing monuments to bear witness to the general destruction which, in a past age, took place. The power which caused it must have been great and persistent, and can only be determined by the evidence it has itself left impressed on the field of its operations, and which, if correctly read, will unerringly lead to its detection. This reading points clearly and unmistakably to water aggregated in broad and shallow seas as the author of the stupendous work.

The deposits of pebbles, clays, and soils; the great landslides; the mounds, cliffs, and terraces, and the inclination of the disturbed rocks, marking the country so persistently and conspicuously, could have been caused in no other way. These seas were no doubt connected with an ocean, or deeper and more extended waters, lying to the southward and westward; but at what era of geological time is somewhat uncertain, except that we know that it must have occurred since the Carboniferous age, for the upper Coal-measure and Permian rocks are those destroyed.

Coëxtensive with this area of devastation, as far as I have had an opportunity to examine it, and, I presume, coëxtensive with its entire limits, there is scattered over the country — resting upon the surface or buried under recent alluvial deposits — silicified wood which grew at a time intermediate between the carboniferous vegetation and our recent forests. The carboniferous wood is invariably imbedded in the stratified rocks, while this intermediate wood is invariably upon the surface, or resting under recent alluvial or vegetable deposits. This would indicate that portions of Kansas, at least, were covered with forests at the time this widespread destruction began, and subsequent to the Carboniferous age, portions of which must have been swept away and destroyed by the submergence of the country, while other portions of it, where the conditions were favorable, were silicified in the mineral waters of the seas, and left scattered over the old sea-bed in positions at or near where they are now found, when the land, for the last time, in southeastern Kansas, emerged from the water.

The petrified remains of this intermediate forest, when its limits are fully known, may give some clue to the time of this era of destruction. To the westward, in the region of middle Kansas, the bones of species of animals now living, and the remains of man, have been found buried under alluvial deposits of wide occurrence and at considerable depths below the surface. If the intermediate fossil wood should be found, as it probably will be, associated with these buried remains, it will render the probability great that this era of waste was comparatively recent, and that man may have reposed under the shade of the forests which preceded it, and which were involved in its devastations. But there is an equal probability that it may have occurred at an earlier date of the world's history.

This last era of submersion in Kansas seems to have been one of destruction, for no fossil remains of sea life seem to have been left to indicate the age of occurrence; and to determine this a resort must be had to preceding life, or synchronous air-breathing animals which may have been carried out by ocean currents and buried under their deposits.

The absence of life, or the fossil remains of life, of this era, is not to be wondered at when we consider the widespread destruction which took place in it. All of the time, rocks, which were torn from their beds, were destroyed utterly, either by the chemical action of the acids in the water, or ground up by the attrition caused by waves and currents — or, most probably, by both these causes combined — and carried away, in part, to distant and deeper waters, and in part left to form the soils of the local valleys. The more enduring silica was rounded by the action of the water, and left in the beds so widely distributed over the country. Where the destroyed strata were composed of limestone alone, no pebbles are to be found, but where the lime-rocks contained masses of chert, or where the strata were composed of chert entirely, the pebbles are found, and the beds vary in thickness in proportion to the amount of material torn down. Where the destroyed strata are in a locality of sand-rock, and composed of sand-rock alone, the gravel-beds are composed of their fragments alone. There may have been, and undoubtedly was, some drifting together of the pebbles, caused by the waves and currents of the sea, but in the main they are confined to the locality where they were torn down, and are nowhere of any considerable thickness. There are now in the museum of the University of Kansas perhaps a hundred specimens of fossil shells, collected from these beds at various and widely-separated localities, identical with the undisturbed fossils of the respective localities where they were found, and which prove conclusively, if additional proof were needed, that the pebbles composing these beds are but the more enduring parts, or silica, entering into the composition of the local rocks destroyed. The silica, being impervious to the acids which aided the destruction of the lime-rocks, remains imbedded where showered down from the general ruin, and as left when the land emerged from the water, except where the beds have been since locally altered, to a limited extent, by rivers and other streams of water cutting through them.

I am aware that erosion and changes in the elevation of land, of continental extent, occurred during Post-Tertiary time, but it is not probable that all the changes happened at the same time, and we must look to the respective changed localities to determine the relative ages when this work was done.

In this paper I have considered southeastern Kansas only, and have attempted to sketch the condition of things wrought out by natural forces in it.

IN THE DACOTAH.

BY ROBERT HAY.

Across central Kansas, from north to west of south, stretches a belt of country, marked in ravines by rugged sandstone rocks, and by long-rounded slopes on the prairie. This belt belongs geologically to the lower part of the Cretaceous system, known as the Dacotah formation. To travelers on the Central Branch Railroad, passing through Washington and Cloud counties, these sandstones are conspicuous objects. On the line of the Kansas Pacific, the same sandstones, underlaid by colored shales, make the wild country from Bavaria by old Fort Harker to Ellsworth. On the Santa Fé Railroad, a single hill standing out in the broad valley of the Arkansas, covered on its precipitous front with names of visitors—archdukes and naturalists—a hill of varied sandstone, capped with chalk, is the sole mark left by the tremendous erosion of a million years that here too the Dacotah formation occupied its place. Away north in Nebraska and to British America, away south in the Indian country and Texas, the same sandstones appear. The same, but varied—varied, but still the same.

At our northern State line, the surface-development of the Dacotah is about thirty miles across, forming the bluffs of the ravines on the west side of the Little Blue, and disappearing under the Inoceramus limestones of the Benton series in the west of Washington county, north and south of Haddam. Further south, the belt is wider, in some places exceeding fifty miles. This is probably due to a greater slope of the surface in the south, in past ages, causing greater erosion of superincumbent deposits.

The hill in the Arkansas valley is forever wedded to a tale of terror. It is the famous Pawnee Rock. But a little shred chipped from it tells another story. It is marked with the remains of an ancient flora. Further north, in Ellsworth county, are ravines with precipitous sides, on some of which a lost race has carved hieroglyphics of war and travel; and there are huge single rocks, like giant pulpits, standing out and alone. In Ottawa county are the worn pinnacles and crags of Rock City. In Washington county the bold sandstone cliffs are seen resting on permian limestone, while their upper surfaces have been ground by the huge hard boulders of the glacial age. And in all these places are the relics of the Old World flora leaves—dicotyledonous leaves. Other of our counties have them—Clay, Cloud, Saline—and they are found away north and south far beyond our borders. Professor Mudge and others have estimated the thickness of the Dacotah at about five hundred feet, and this thickness is composed mainly of sandstones, those near the top in most of the exposures we have seen, being light-colored, and the lower ones dark brown or red. In some places it is blood red, streaked with yellow; and when the sun shines on it we have a gorgeous glory. The coloring-matter is largely composed of some compound of iron, and in places this has oxidized in most curious forms, suggesting by their vitreous surfaces the action of fire. In many places we have picked up specimens with a botryoidal surface not to be distinguished from kidney hematite from Europe and elsewhere. Then there are nodules